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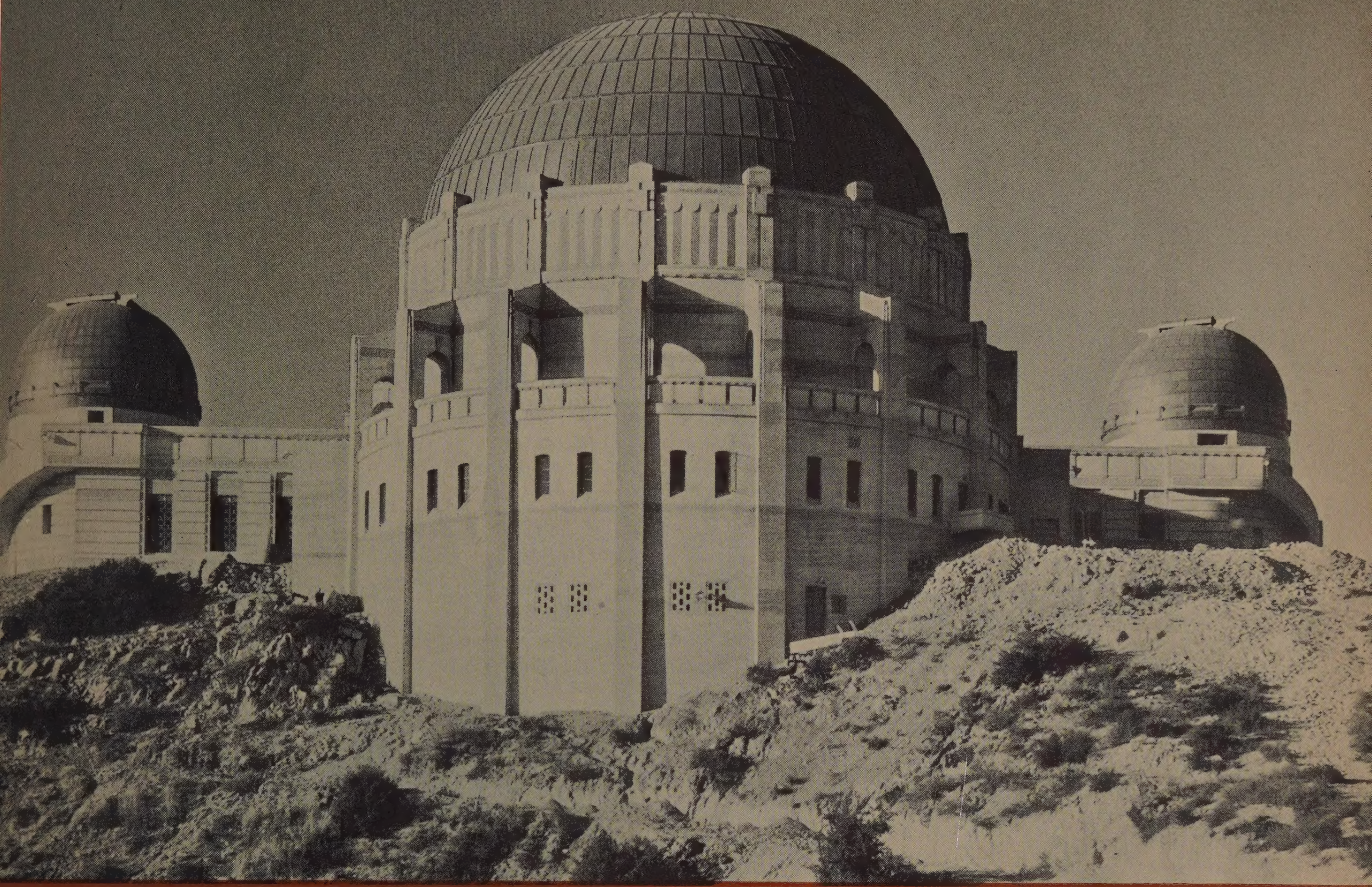
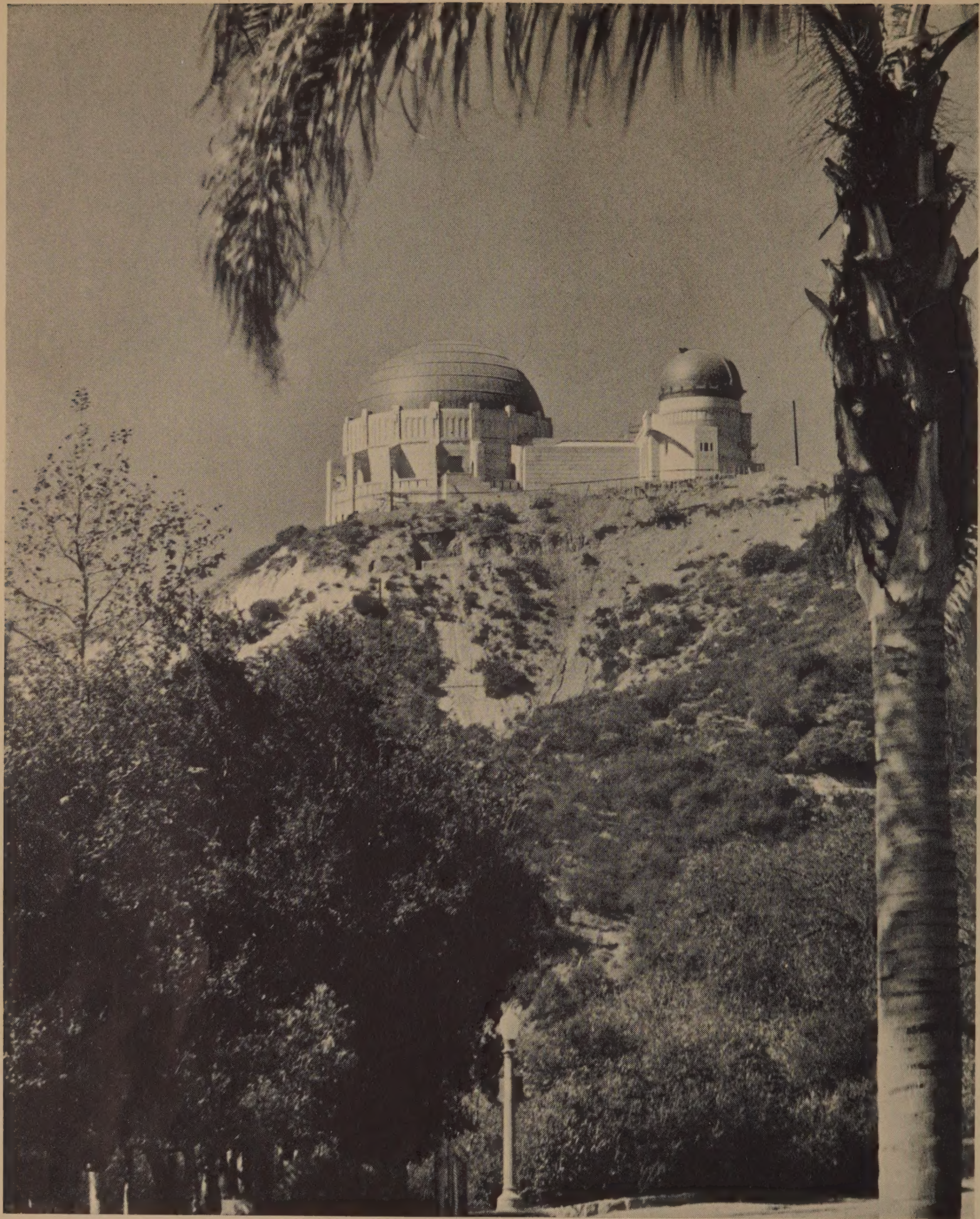


ARCHITECTURAL CONCRETE

VOLUME ONE NUMBER TWO



GRIFFITH OBSERVATORY
Los Angeles, California
Austin and Ashley, Architects
Wm. Simpson Construction Co., Contractors

Alone on its rugged mountain—see cover—or framed by a California palm tree, Griffith Observatory seems to entreat the sky. It is a symbol of its purpose—to discover and teach the mysteries of the worlds above.

Architectural CONCRETE

Griffith Observatory

A Science Center for the City of Los Angeles

By JOHN C. AUSTIN, A.I.A.

ON THE west slope of Hollywood Mountain the Griffith Observatory and Hall of Science is rapidly nearing completion. When finished and fully equipped, it will house a planetarium similar to the Adler Planetarium at Chicago and the one in Franklin Institute, Philadelphia; a 12-in. telescope; a Coelostat; a model of a portion of the moon's surface; a Foucault pendulum (named after its inventor, the French physicist), and numerous other items of scientific interest. It was expected that the building would be completed and equipped by the beginning of 1935.

Los Angeles owes this fine municipal science center to the generosity of Colonel Griffith J. Griffith who, in 1896, presented 3,015 acres to the city of Los Angeles for park and recreation purposes and, upon his death, left a will bequeathing a sum of money sufficient to build a Greek Theater—completed in 1930—and an Observatory and Hall of Science. The money derived from the trust was administered by the Security-First National Bank of Los Angeles in conjunction with the Board of Park Commissioners of the city. When completed, the Griffith Observatory will become the property of the City of Los Angeles.

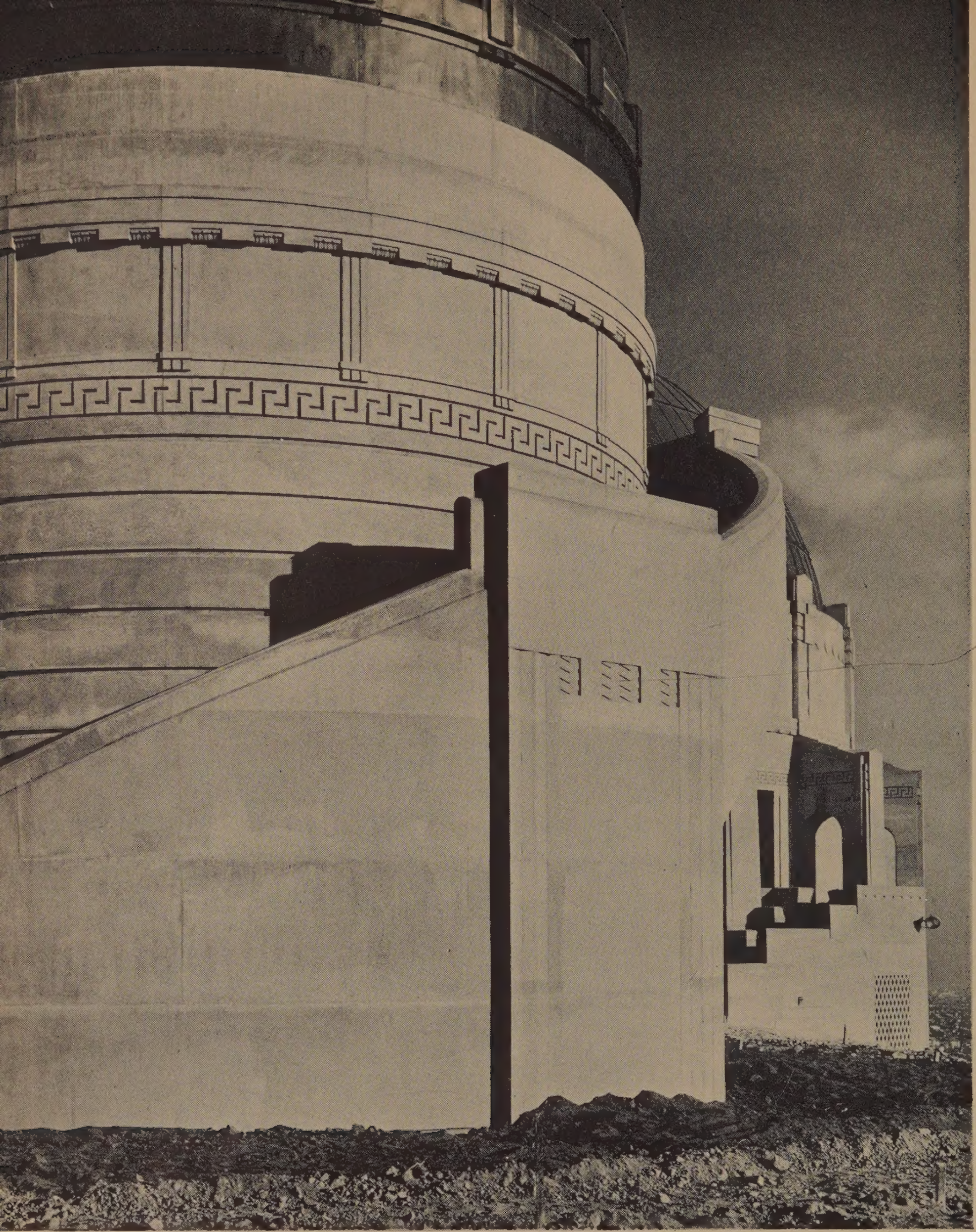
The design of this building was not intended to follow any of the accepted architectural styles, although the ornamental features suggest modifications of the Greek—a style found to be readily adaptable to the use of concrete.

Reference to the illustrations makes clear that the placing of concrete could be stopped at many places without encountering difficulty in concealing "cold joints." Rustication, vertical ornaments and other architectural features made it possible to continue depositing concrete in masses of reasonable size, thus avoiding the necessity of prolonged operations in order to finish placement at a suitable plane.

While structural steel was employed in the construction of the four domes, those over the planetarium and the Foucault pendulum are roofed with concrete and copper. The domes over the galleries are of the revolving type with mechanically operated shutters, roofed with copper only. Supporting members of the roofs of the east and west galleries are also structural steel, completely fireproofed with concrete. These roofs serve as promenade decks and are reached by curved concrete stairways at east and west ends of the front section of the building.

The building is fireproofed throughout and, with the exceptions noted, the entire structure is reinforced concrete designed to resist lateral forces to the extent of 10 per cent gravity. Owing to the fact that California is subject to earthquakes in various localities, it was deemed advisable to construct a building that would compare in strength with those in other parts of the world which have successfully resisted tremors of greater intensity and duration than previously experienced in California. Reinforced concrete buildings, when well designed and properly supervised, have generally suffered but very slight damage although located within severely affected areas.

Concrete used in construction throughout Griffith Observatory was accurately proportioned. Extreme care was exercised in the selection and grading of aggregates. This was done on the basis of uniform gradation from fine to coarse. Aggregate was delivered to the site in three groups; sand, pea gravel and rock. The sand varied from fine, retained on a 100-mesh screen, to that which would pass a No. 4 screen. Pea gravel was of such size that most of the aggregate was retained on a ¼-in. mesh screen and passed through a ⅜-in. screen. Rock varied from ¾-in. to 1½-in. Rock and sand were blended separately at the plant with the sizes available to produce the best graded material.



West tower of Griffith Observatory. The stairway with curved walls, including the decorative band, and other detail are concrete cast in plywood or Presdwood forms and plaster waste molds.

A Tyler standard screen analysis of the aggregates, as delivered, was made on the site and the percentage of various sizes was plotted on prepared charts. These charts had equal divisions on the vertical side, reading in percentage of material retained above each sieve. The Tyler sieve sizes were plotted at predetermined distances on the horizontal side. This enabled one to plot the percentage of material retained on each particular sieve, thus producing three separate curves of the three aggregates used. A straight line drawn from the lower left-hand to the upper right-hand side of the chart, therefore, represented an ideal grading of the aggregate. It then became necessary to select the proper percentage of each of the three materials already plotted so that, when they were combined, the final resulting curve approached the ideal straight line.

The concrete was mixed in accordance with the water-cement ratio theory. The aggregates were generally delivered to the site on the day before the concrete was to be used, assuring uniform moisture content throughout the aggregate. This resulted in considerable saving of time in manipulating the water measuring devices. The water content of the rock and sand was measured with an hydrometer and calcium chloride solution. The amount of water in the aggregate was deducted by means of overflows from the water measured for the batch.

The average strength of the concrete at 28 days was 2,430

lb. per square inch, and the mix, by volume, was approximately 1 to 7.

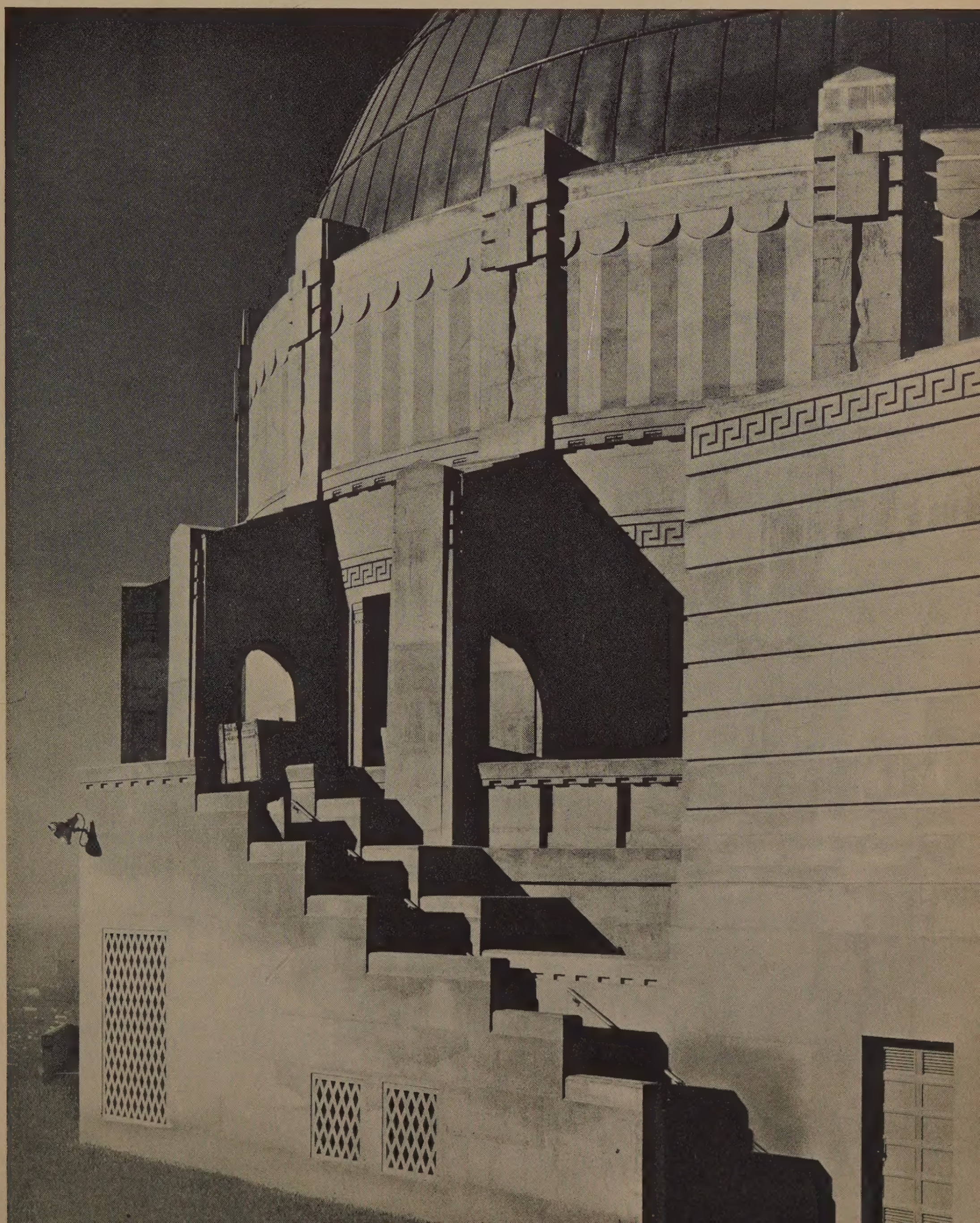
The concrete was distributed by means of buggies and dropped in place through canvas "elephant trunks" to prevent the concrete accumulating on the molds and rustications above the general level of that already placed. Wood tampers and electric vibrators were used to puddle the concrete into position in addition to hammering of the forms on the exterior with wooden mauls.

Vertical construction joints were made in the usual manner with wood bulkheads. Horizontal construction joints were invariably covered with at least 2 in. of sand and pea gravel grout before depositing the standard concrete.

Particular attention was paid to the possible effect of shrinkage. Concrete of a drier mix was therefore used in the upper portions of the walls to minimize shrinkage. Construction joints were established at horizontal breaks to permit shrinkage to take place before succeeding lifts of concrete were deposited.

Great care was exercised in depositing concrete in the forms to prevent seams, rock pockets or unsightly lines on exterior surfaces. By means of tampers and vibrators, a very dense concrete was secured; and exposed surfaces were, generally, so compact, smooth and perfect that only minor pointing was necessary. Arrises were sharp; and ornamental features, with few exceptions, were found to be in perfect condition upon removal of the forms.

The use of waste molds, Presdwood and plywood in place



The South or Planetarium tower reflects the value of rigid control in mixing and placing concrete. Even, pleasing texture and sharp detail—no matter how complex—are the result of good form work and quality concrete.

of ordinary boards, produced not only splendid, smooth surfaces but an illusion of massive masonry. This can readily be seen in the illustrations, especially of the south side of the building where the lines shown were produced solely by the junction of the plywood or Presdwood sheets and not by mechanical means of any sort. In other words, no special effort was made to produce these lines, nor was any attempt made to simulate stone or any material other than concrete.

After the pointing was finished, all concrete surfaces were sandpapered and thoroughly washed to remove stains that resulted from oiling the forms in direct or immediate contact with the concrete. While some stains persist, it is felt they do not constitute a defect. This is particularly true since the building seems to fit admirably into the rough and rugged hillside.

Summing up, it would appear that good form work, proportioning of aggregates, rigid adherence to the correct cement and water ratio, adequate manipulation of the concrete and conscientious supervision will—according to experience on Griffith Observatory—produce a building that will endure indefinitely. Obviously, the building must be designed scientifically.

The figures in the monument at the entrance to Griffith Observatory, cast in plaster waste molds, were sandpapered to a smooth finish.

The plan of the observatory indicates the nature of the problem involved, and illustrations exhibit the degree of restraint that was used in the arrangement of mass and details both on the interior and exterior. Special attention is directed to the design and construction of the massive doors in the entrance. These are of cast and extruded bronze, artistically fabricated and assembled in a manner to conceal the structural parts.

All windows in the main section containing the galleries are protected by means of heavy grilles constructed of wrought and cast iron assembled as single units. The design of these grilles harmonizes with that of the entrance doors, and their execution exhibits a high degree of craftsmanship.

The walls of the central octagonal foyer are faced with Italian travertine marble to, and including, the molded and ornamented cornice over which there are mural paintings. The foyer, south gallery, and parts of the east and west galleries are floored with marble tile. The planetarium is floored with cork tile. Other floors are tiled with rubber, while in the administration department the directors' room and library are concrete covered with carpet.

The eight mural paintings and the vaulted ceiling over the foyer were executed by Hugo Ballin. The descriptions under the illustrations tell of a variety of incidents in the march of Science through the ages in all lands.

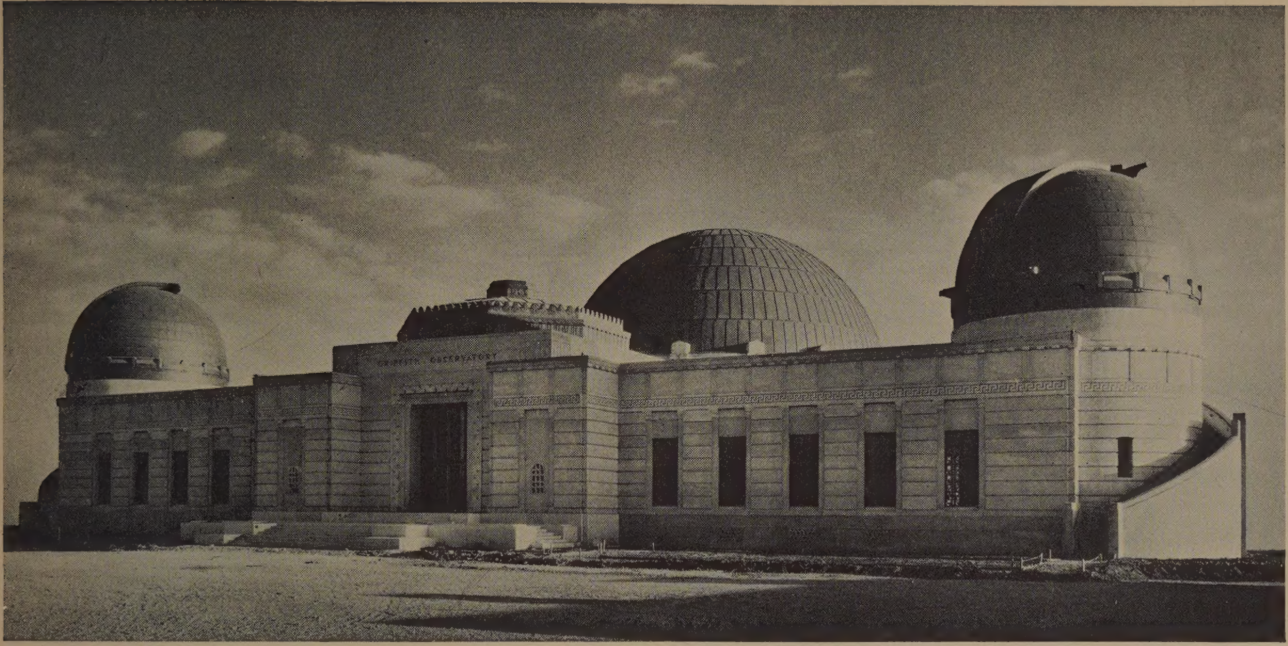
The ceiling of the planetarium was constructed as a dome suspended from the steel and concrete frame of the outer shell forming the permanent roof of the dome. This ceiling was first plastered on metal lath, then covered with 6-in. by 12-in. rock wool tiles $1\frac{1}{4}$-in. thick. These tiles were perforated with $\frac{3}{32}$-in. diameter holes spaced $\frac{1}{4}$ in. apart in two directions. Each tile was secured to the plaster backing and the surfaces trimmed and sanded until they conformed to the sphericity of the dome. After these tiles were placed, the whole surface of the ceiling was sprayed with sufficient flat acoustical paint to yield a satisfactory, uniformly white surface.

At the spring line of the dome, the material is silhouetted to represent the landscape surrounding the building. The silhouette represents mountains, cities and ocean, all of which are in close proximity to the base of the mountain upon which the building stands. It is possible to indicate sunset and sunrise by proper manipulation of the planetarium and its dimmers combined with the trough lighting. An ingenious design and arrangement of light pockets makes it appear that the stars pass behind buildings and mountains.

The front steps are of California light grey granite.

The building was erected under the general supervision of the architects by the William Simpson Construction Company. Milton W. Nigg, engineer, was active superintendent during the entire construction period.

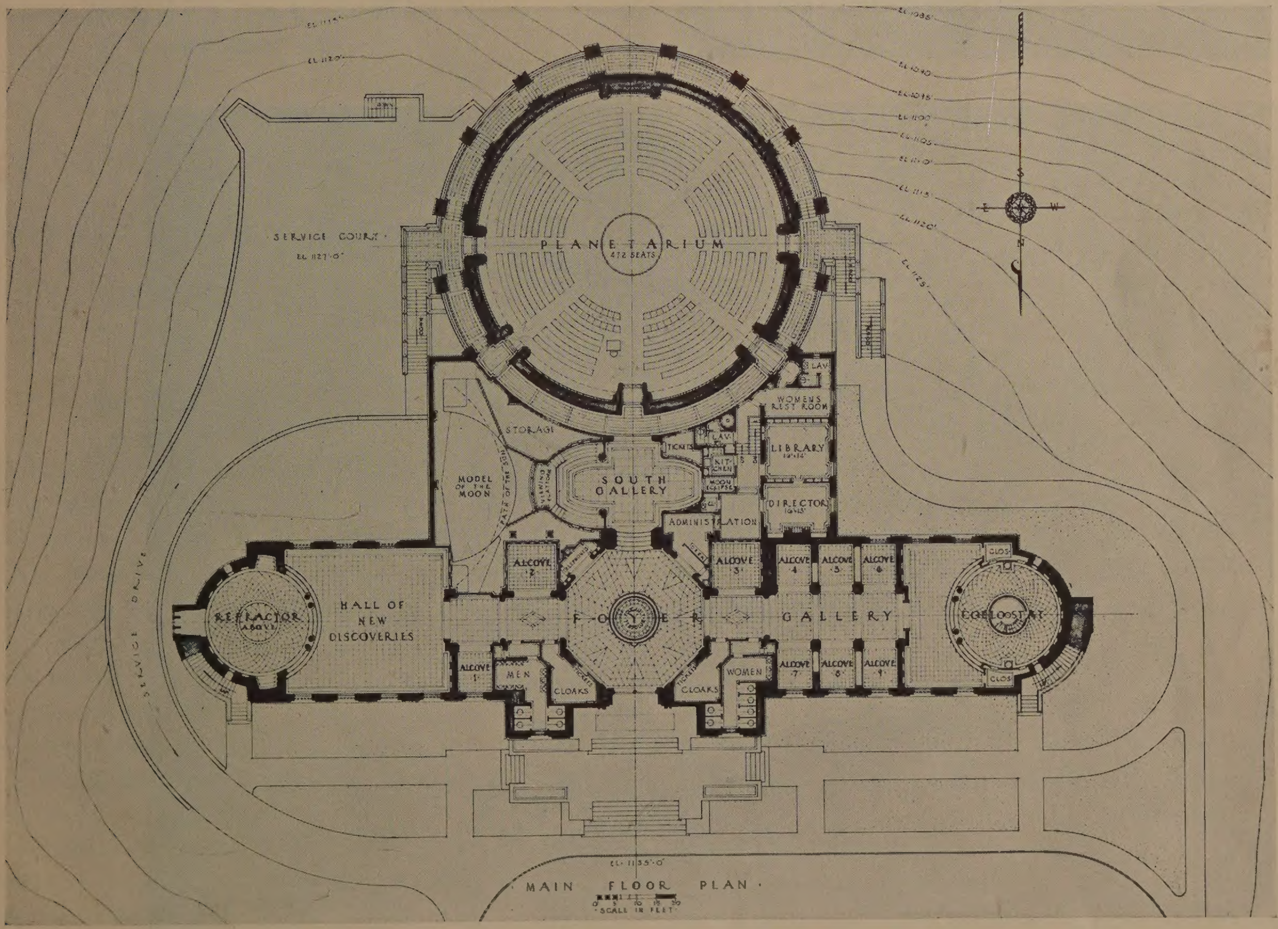
Co-operating with the architect were the Board of Park Commissioners; a committee representing the Security-First National Bank; an advisory committee named under the terms of the Griffith will and a general advisory committee.



FRONT ELEVATION

Griffith Observatory, Los Angeles, California

MAIN FLOOR PLAN



Exposed Concrete Ceilings
Y. M. C. A., Harrisburg, Pa.

Lawrie and Green, Architects

Right—Men's Social Room. Beams and slabs were sized and antiqued before painted decoration was applied through stencils.

Left—Special arch pans were designed for forming concrete in the main stairway. Decoration was applied directly on the concrete.

Below—Scenes depicting typical "Y" activities of interest to youths were painted on the exposed beams in the Boys' Social Room.

An Architect Makes A Decision

By M. EDWIN GREEN, A.I.A.

AFTER the dedication of a new building, there invariably comes to my mind certain stirring stanzas of Rudyard Kipling's *Recessional*—

"The tumult and the shouting dies,
The captains and the kings depart;

. . . .

Lord God of Hosts, be with us yet—"

On the day of dedication, all are lavish with their praise or at least politely approving; but tomorrow they will be gone and their interest, intrigued for the moment by something new, cannot but dull and wane with time. What of the building ten or twenty years hence? That is the period the architect looks forward to with apprehension.

It is this thought of the future that pulls the architect up suddenly, making him wonder whether his plans and visions will wear, forcing him to decide how his designs may best be expressed to endure materially as well as aesthetically. The result is another thorough study of the function and uses of the building. This was true in the designing of the Harrisburg, Pa., Y.M.C.A.

The question of upkeep cost is of major importance in the operation of any Y.M.C.A. building, as this item, when included in the budget, is ordinarily cut to the irreducible minimum. The decision to use exposed structural concrete ceilings was arrived at after careful consideration of the strenuous use to which such buildings are subjected, and then trying to select a material which would require relatively little upkeep.

For the Boys' Social Room and the Men's Social Room ordinary smooth steel pan forms, similar to those used in the construction of the rest of the building, were used. In the Billiard Room and the Men's Lobby, a special arch pan was designed and made up by a local sheet metal contractor to be used in the same way as ordinary pans.

Care was taken in laying out the structural work to locate the beams symmetrically and to spade thoroughly as the concrete was placed. After removal of the forms, the marks of the pan points were smoothed with "Bondcrete" but the rest of the beam was left untouched. Stencil designs were cut and special concrete paint applied after the surfaces were sized and antiqued. Strong colors were used in the stencils, with blue and red predominating in the rooms with north and east exposures, while considerable green was introduced in rooms having a south and west exposure.

One must judge for himself the effectiveness of this decoration, but its permanence and durability cannot be doubted.

Architectural CONCRETE

ARCHITECT · ENGINEER · CONTRACTOR

IN THIS ISSUE

JOHN C. AUSTIN reveals there is technique and art in mixing and placing (Page 3) as well as in designing . . . An architect who would build for the future should think it over (Page 9) before deciding, says M. EDWIN GREEN . . . Because everybody likes them, here are FOUR MORE PAGES of details (11 to 14) for your A.I.A. files . . . HOMER M. HADLEY describes the wedding of concrete and Gothic in GRACE CATHEDRAL (Page 15) . . . JOHN T. VAWTER, seeing architectural concrete on the right trail (Page 17), visions its progress in the light of new theories of design . . . The march OUT OF THE RED goes on (Page 22)—a new list of jobs and the men who are doing them.

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PORTLAND CEMENT ASSOCIATION

33 West Grand Avenue

Chicago

An Important Job

There is an unquestionable improvement in the building business. Many forces are at work which presage better days ahead. While these forces stimulating building are gaining strength, there is *an important job* to do, requiring the knowledge of architects, contractors and engineers—a job which will give sorely needed employment to many in those groups.

A survey of building codes shows that few are of recent origin. Many smaller cities and towns are entirely without building regulations. Some codes in force are lax where they should be rigid and others make the cost of building inordinately high by unreasonable requirements. The few bright exceptions establish rather than deny the rule.

There is urgent need for adequate, rational state building codes which would serve not only as the ruling codes for smaller communities, but also as guides for the revision of codes in larger cities. Such codes must be intelligently drawn by competent men in the building profession.

The State of New York has already set up machinery to bring this about. *Why not do the same in every other state?* Through the cooperative effort of the architects, contractors and engineers of the country, acting through their professional and trade organizations, such a movement can be started, leading to the establishment in each state of a building code board. The members of the boards should be drawn from the memberships of the organizations within the building profession. The boards should be empowered to employ competent men from the ranks of the building industry, to assemble data and prepare tentative codes for final action by the boards. Ultimate adoption by the legislatures and establishment of permanent boards to administer the codes should follow.

The advantages to be gained from such a movement are manifold, including: 1. Immediate useful employment of many in the building profession; 2. Uniform state-wide building regulations, insuring economical construction and recognition of advanced methods of design; 3. Establishment of the ground work for a national building code.

GRACE CATHEDRAL, SAN FRANCISCO, CALIFORNIA

Lewis P. Hobart, San Francisco, Architect
Cram and Ferguson, Boston, Mass., Consulting Architects
Dinwiddie Construction Co., San Francisco, Contractors

FORM and detail of the entire Grace Cathedral are executed wholly of concrete cast in place, with the exception of cast stone tracery for the windows and main entrance details. Turrets, finials and rich cornices, although intricate in design, were constructed without special difficulty. The steeply pitched roof is a concrete slab cast in place and supported by steel trusses and beams. Within, the graceful columns, the characteristic pointed arches and the walls are of exposed concrete.

As should be done in the design of all buildings whether constructed of brick, stone or concrete, the material of which Grace Cathedral was constructed was kept in mind in planning the building and in designing of detail. Belt courses, sill lines and the set-backs in the buttresses made natural levels for horizontal construction joints at convenient heights. Deep undercut detail was avoided without restricting the architect or losing the spirit of the true Gothic design.

Unlined wood forms sheathed with 6-in. T & G boards were used for all flat areas. Simpler details were also cast in wood forms, using run wood moldings and milled lumber. The more intricate detail was formed in plaster waste molds. The cost of even the rich detailing of a Gothic church done in concrete is little compared to that of hand carved masonry. This is because the cost of plaster molds decreases rapidly as the number of repetitions of the detail increases, since the waste molds are all cast from a single master mold.

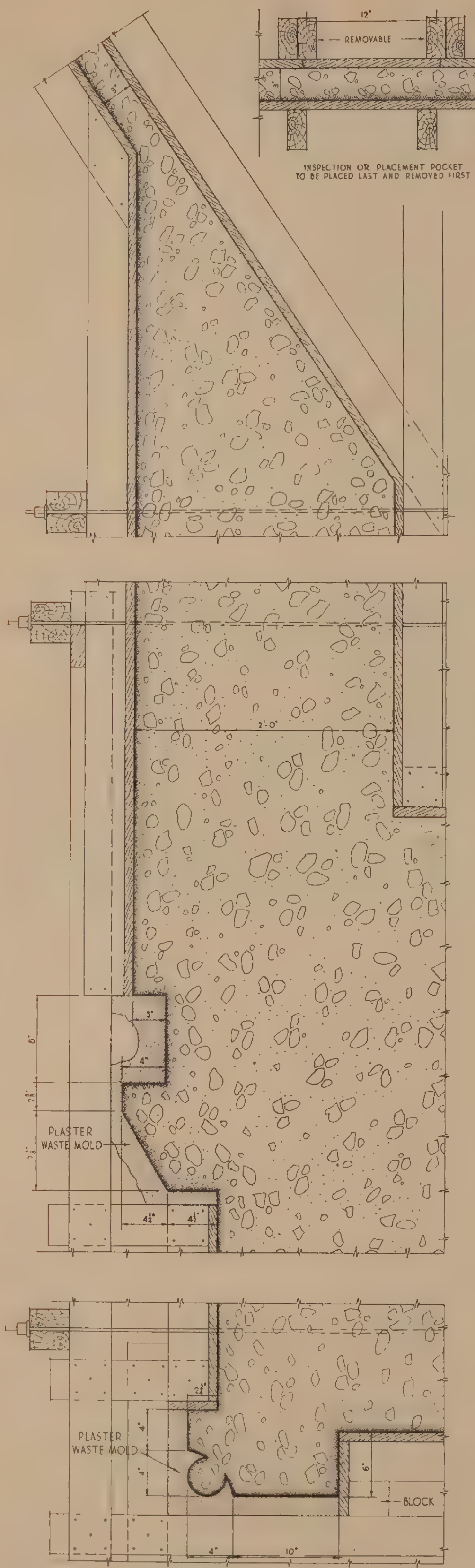
All exposed concrete surfaces, both inside and outside have a warm, interesting texture. This was the result of bush hammering which removed the film of cement paste from the surface. At the same time, the tooling cut through the multi-colored aggregates producing an harmonious blending of colors. Obviously, not all aggregates lend them-

selves to this treatment; the style of architecture, the occupancy of the building and other factors should be taken into consideration.

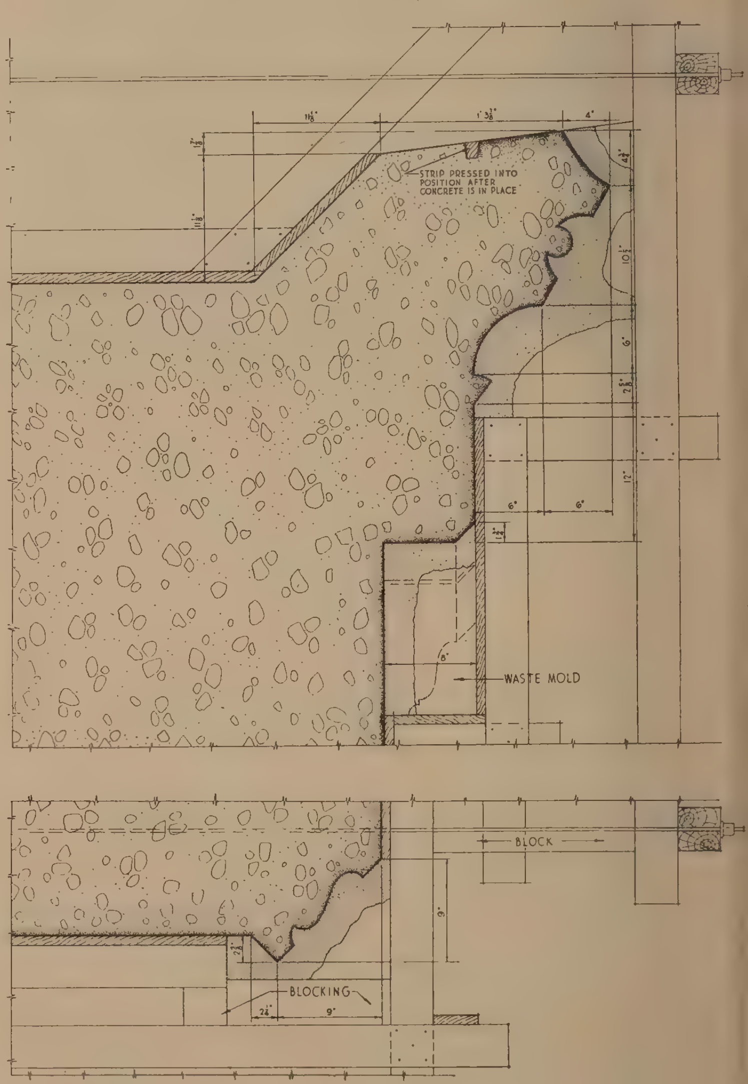
Some interesting construction problems were presented in the form work, a few of which are illustrated in the accompanying drawings. The more common details, somewhat similar to those which might be used in other jobs, have been selected rather than those unique in a Gothic church.

The thin slab of the sloping roof required the use of a top form in its construction. In order to get the concrete into the small space, inspection pockets were provided in the forms 3 to 4 feet apart. It was difficult to puddle the concrete through the inspection pockets; therefore the forms were vibrated with mechanical vibrators and by rapping with mauls to compact the concrete.

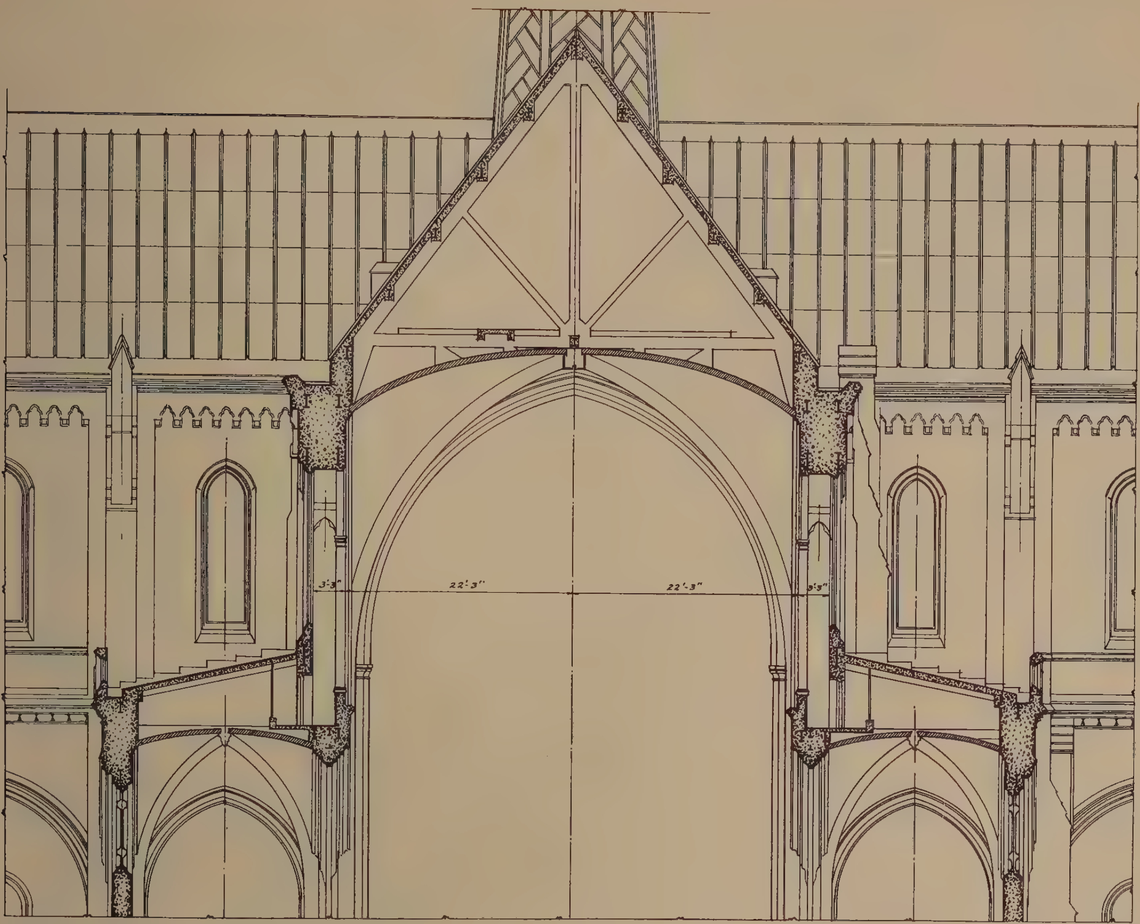
Because of the curved section of the Guastavino tile vaults, plaster molds were used to form the recesses to receive the vaults. A wood form could have been used but the cost would have exceeded that of plaster molds. When the forms were stripped the waste molds were left in place to protect the concrete detail from damage. The



ROOF AND UPPER PART OF NAVE

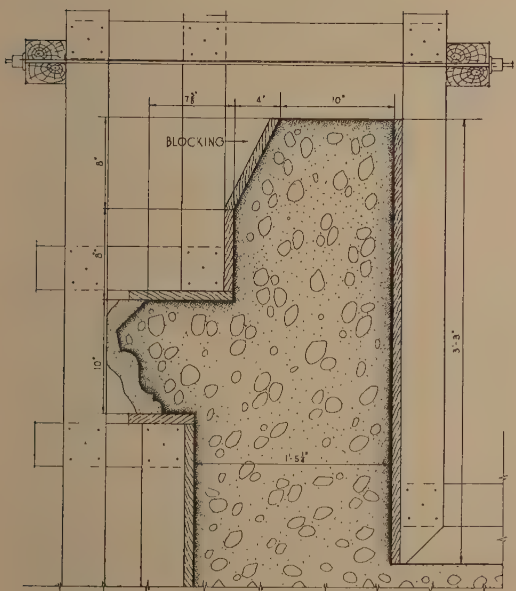


CORNICE AND WINDOW HEAD

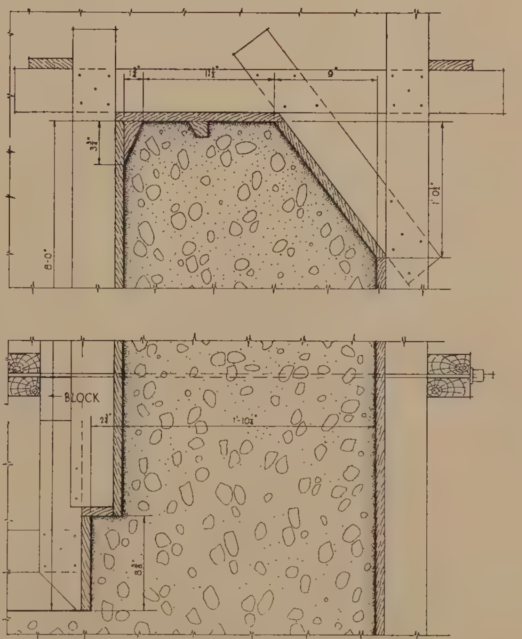


Sketch made from architects original drawing

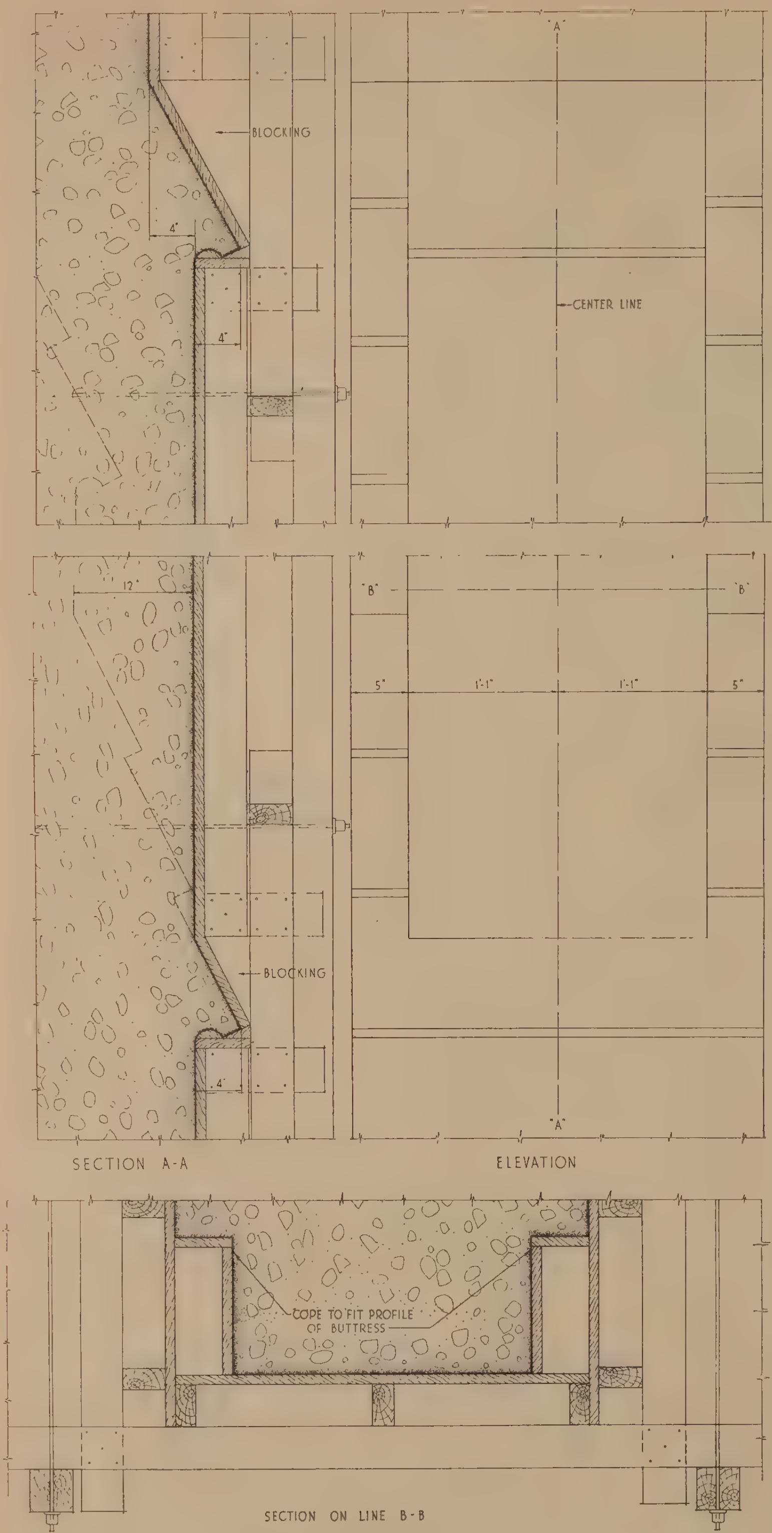
SECTION THROUGH UPPER PART OF NAVE



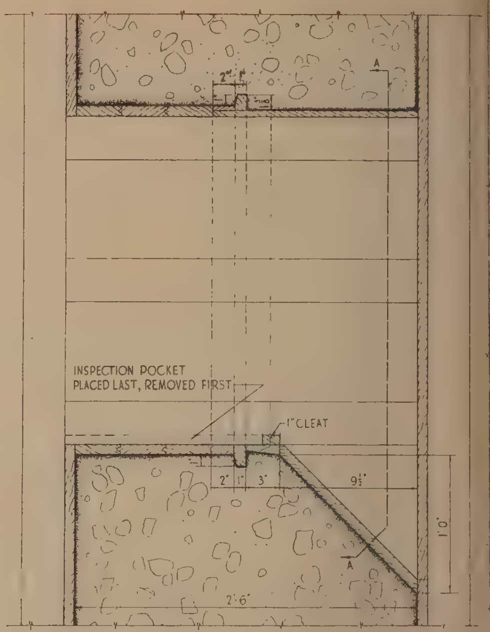
INTERIOR SILL



EXTERIOR SILL



CLERESTORY BUTTRESS



TURRET WINDOWS

molds adhered firmly to the concrete and were cut away with chisels, especially where the detail was slightly undercut, as at the head of the window in the upper part of the nave.

Waste molds used for forming the gutter curb were made in pieces 4 to 6 ft. long. The joints between sections were pointed with plaster of paris after the forms had been lined up; otherwise slight movement of the forms might have broken the pointing.

The concrete for the gutter curb was brought up to the level of the top of the form. The raggle strip was then pressed into the surface and the concrete was struck off with a trowel. An edging tool was run along the edges of the raggle, to prevent roughness and irregularity when the strip was removed. This was done along the outer edge of the gutter curb and in all similar places where no top form was used, as illustrated by the detail of the interior sill in the upper part of the nave.

The forms for the turret windows were constructed with beveled milled strips at the corners to make removal of forms easier. The concrete at the center of the windows was puddled through the inspection pockets in the sill of the forms. The concrete was brought up to a point about 12 in. below the sill and then allowed to settle 30 to 45 minutes before the forms were completely filled. There was then less tendency for the concrete to shrink away from the sill.

The construction practice followed on this job is entirely satisfactory for any concrete work involving similar detail.

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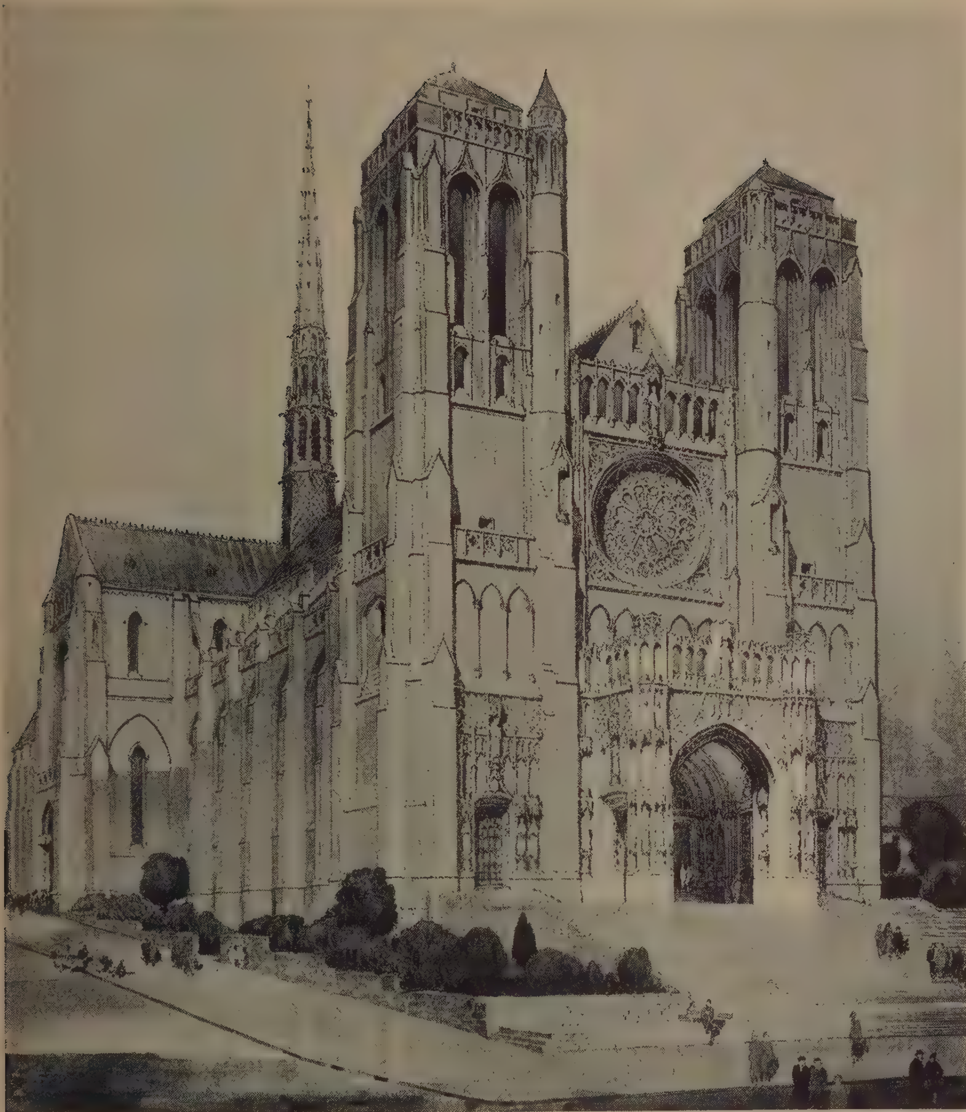


"It is unquestionably of America and of the twentieth century—one of the most impressive, convincing and promising schemes for an American cathedral."

Lewis P. Hobart, architect. Cram and Ferguson, consulting architects. T. Ronneberg and Henry D. Dewell, structural engineers. Dinwiddie Construction Co., contractors.

Grace Cathedral—Gothic In Concrete

By HOMER M. HADLEY*

WHEN it was first proposed that reinforced concrete be introduced to that patriarch of tradition and experience, Gothic Architecture, some thought the meeting could result only in embarrassment. These fears were reasonable, and they might have been justified had not Grace Cathedral or some other truly Gothic structure been built to prove that architectural concrete is adaptable to a form and style that, during a long history, had been expressed only in stone or other masonry.

With approximately the first half of the building now nearing completion, people who have seen Grace Cathedral call it beautiful Gothic; and they can see that it is concrete, used neither in imitation nor as a substitute for other materials; but used here because it could express the form, mass, proportion and even detail of an old style in its own, new way.

When completed, Grace Cathedral will occupy an entire city block on Nob Hill, San Francisco. That it will be a massive structure is indicated by the plans and renderings,

*Regional Structural Engineer, Portland Cement Association, Seattle.

Facade of South Transept, Grace Cathedral. With the exception of the cast stone entrance and rose window, all intricate detail was cast in plaster waste molds.

and assured by the part now built from the transept to the apse, already a large edifice as compared with other churches. There are still to be built the major part of the nave, the impressive twin entrance towers and the broad terrace.

Regarding the design of Grace Cathedral, Ralph Adams Cram, an authority on Gothic and a consulting architect on the project, has stated:

"It is not in any respect archeological. There are motives which may be traced to thirteenth, fourteenth and fifteenth century work in England, France and Spain. None of these has been used after a servile fashion. No one could mistake it for a copy of an ancient structure. It is unquestionably of America and of the twentieth century; yet with equal certainty it proclaims not only the vitality of the religion that brings it into existence, but also the unbroken continuity of this force as it follows backward, century after century, to the great moment when, in Europe, Christianity became fully self-conscious, and so expressed itself through the art it had brought into being . . . . Lewis Hobart, the architect, has produced one of the most impressive, convincing and promising schemes for an American cathedral that has thus far been brought forward during the process of creating in America a logical and consistent architectural expression of the Christian faith and the Christian polity."

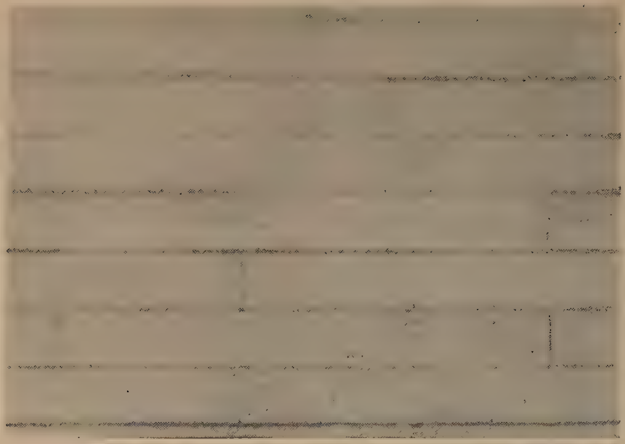
As in all Gothic structures of an ecclesiastic nature, the vaulting of Grace Cathedral directs the form and detail of the building. The arches of the vaults are imposted on the tall pillars which separate the nave from the aisles and mark the walls of the transept. Between the buttresses, following the curves of the pointed wall arches of the vaults, are the familiar lancet windows. In this modern cathedral, as in the great cathedrals of the late middle ages, form dominates detail. And this is further true in Grace Cathedral because the familiar features—buttresses, arched windows, finials, niches and cornices—are decorated with simple, dignified tracery and sculpture. So, it may be said, in appearance and function this new edifice does not depart from the Gothic tradition.

It required many years to build old Gothic cathedrals. Tons of rock had to be hewn, carved, sculptured and then built up and bonded. Strength was obtained by massive structure. Not so Grace Cathedral. It was formed in place, structure and detail, by continuous operations of placing concrete over a light, built up, lattice steel frame. It is strong because it is rigid—rigid enough to resist earthquakes. It is massive in appearance but not in weight, as compared with the old masonry structures, and it is therefore economical. While it was not hastily constructed, it required much less time and arduous toil to build it. It is in these points—which may all be recognized as advantages—that the cathedral departs from the Gothic tradition.

The light steel work about which the concrete is placed is technically the structural frame. In reality, however, it is tension reinforcement for the concrete which provides the compressive strength to carry the load. In principle, this framework has the same effect as reinforcement bars, and of course there is additional reinforcing steel throughout the walls and roof slabs. The steeply pitched roof is supported by steel trusses fireproofed with concrete.

All flat surfaces outside and inside the building were molded in wood forms. The detail—with the exception of the multifoil tracery of the lancet windows and the entrance—was cast in place with plaster waste molds. These included the detail of the cornice, buttresses, finials, octagon columns, arches and the niches provided for sculptured pieces. The window and entrance detail is of high quality cast stone, and the windows are stained glass leaded in designs of appropriate religious figures and symbols.

Looking from the nave toward the sanctuary of Grace Cathedral. Octagonal columns were cast in plaster molds as were the arches.

Surface of Grace Cathedral concrete wall before and after bush hammering. Note that form marks have not been entirely erased.

The concrete used throughout the cathedral was carefully designed by a highly skilled concrete technologist. Mixtures were carefully controlled and aggregates constantly inspected. These are necessary precautions to assure workability and ultimate strength, uniform color and predetermined texture. A slight variation in mix might easily have caused large variations of color. Aggregates from different sources presented different colors, textures and other characteristics which, were they not controlled, might have shown to disadvantage in the finished surface.

As the concrete was placed in the forms—both wood and plaster waste molds—it was vibrated mechanically. In this way a dense concrete with evenly distributed aggregates was firmly bonded to the reinforcement. When the forms were stripped there was revealed not only the bare frame as in the use of structural concrete, but structure and detail integral—ready for the finish treatment.

By bush hammering—or tooling—a texture of surprising quality and beauty was obtained for the exposed surfaces of Grace Cathedral. Rather than removing the cementing material of the surface to expose the aggregate as with the use of acid compounds or retarding agents, tooling with a diamond point shaved off the entire surface. The aggregates and mortar alike were cut, exposing the interior structure of the stones, revealing their interesting and beautiful coloring and formation. It might be suspected that this uniform surface treatment would result in monotonous, unrelieved color and texture. But this was not so. While tooling removed the extruding parts of the form marks, the hardness of the concrete at these points, due to seepage of water from the concrete through the form joints, produced a contrast of both color and texture in variations which give interest and character to the entire surface.

Obviously, the cost of this treatment is more than that of plain exposed concrete; but compared to stone, it is far more favorable although it is in no sense an imitation. The advantages are apparent; it is not necessary to cut stone in blocks or segments and then incur the additional labor and expense of laying, centering, plumbing and pointing. With the placing of the concrete, both the structural elements and architectural detail are completed. Furthermore, similar detail may be cast many times in duplicate plaster molds made from a single model, precluding the close task of carving or sculpturing each piece separately.

The exposed concrete on the interior of Grace Cathedral was treated by bush hammering as was the outside. The vaults, however, and certain portions of the interior walls were faced with Guastavino acoustical tile. Where used, the tile was built up so as to be self-supporting and earthquake resistant. Most of the floor areas are tile.

The interior furnishings of this cathedral are richly appointed in keeping with religious as well as architectural tradition. The Grace Chapel altar of stone, carved hundreds of years ago for use in an old world cathedral, is a gem of medieval craftsmanship. Likewise, the carved wood reredos in the curve of the chapel is an import from ancient times. These relics of the original Gothic seem aptly at home in their new surroundings of modern Gothic. They, possibly more than anything else, symbolize the gracious meeting of concrete and old Gothic.

For those who might criticize the use of monolithic concrete rather than masonry for Grace Cathedral there will be no defense or apology offered. The building should be observed and criticized to determine the effectiveness of its design and the perfection of its detail. It should be examined to discover whether it is or is not true in form and function—not to see, only, that there are no mortar joints. From a distance all structures appear to be monoliths, and it is only when one approaches them that the joints of the masonry and the continuity of the monolith are apparent.

A decorative effect is obtained without a trace of decorative form that is separable from the structure itself in the Exposition Hall, Brunn, Czechoslovakia. Josef Kalons, architect.

Concrete and the New Decorative and Structural Forms

By JOHN T. VAWTER, A.I.A.

Courtesy Dr. Francis S. Onderdonk

THE following article is an extract from a paper intended to stress the importance of the theory of modern design to all those interested in the development of architectural concrete. It is felt by the writer that while the development of architectural concrete to its present degree of perfection is a real accomplishment, there will be still greater dignity and grace in its use when it is properly regarded in the light of the basic principles of design.

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Beginning, perhaps, with the Ingalls Building in Cincinnati, the young plant of architectural concrete had neither flowers nor fruits of its own. It possessed no history or inherited tradition and only such characteristics of hardness, weight and brittleness as to liken it to a kind of stone or terra-cotta. Under these conditions, the wanting parts were borrowed from the storehouse of architectural history. Concrete was used as a substitute for steel, just as steel had been used as a substitute for wood. As a material possessing particular and definite possibilities and limitations of its own, concrete had not yet been discovered. Very naturally, the old forms were retained and the surfaces of the new materials treated in imitation of the old.

Some of the earliest attempts at the surface treatment of concrete imitated the joints of stones, the draft lines and even the rock-face and tool marks of ashlar. Surfaces were bush-hammered, crandalled, vermiculated and treated with all sorts of wire brushes, brooms and chemicals. Dressed lumber was preferred for forms which were frequently coated with thick whitewash, resin or any dressing that would effectively conceal the identity of the concrete and make it appear as stone.

Pressed metal ceilings, themselves first made in imitation

of carved masonry, were in some cases very effectively used as form faces for both wall and ceiling panels; but the double negatives of imitation were yet far from a positive expression of the character of concrete.

With plastic cement, well selected sand and careful workmanship, run moldings were found to be quite satisfactory. Burned clay tile used as "inserts" or isolated spots on concrete surfaces were for a time very popular, and many ingenious ways of securing them in the forms were devised.

Cement tiles in vivid, permanent colors are to be had at less than half the cost of burned clay tile. These are in quite general use in South and Central America, although they have not as yet made their common appearance here in other than experimental work. The treated surface is called Baldicino and being a cementitious material akin to concrete, there is something more satisfying in the use of Baldicino than clay tile in a similar position.

Thrown plaster is effectively used in Mexico and farther south, but for some reason it has been employed here to a very limited extent. The process is precisely what the name implies. Fresh, well-mixed cement plaster is thrown from a trowel in small "dabs" with sufficient force to insure its consolidation. When roughly piled up to a sufficient height, the superfluous plaster is cut away with the same trowel, leaving a directly executed piece of ornament.

Scraffito is one of the most promising methods of obtaining a pleasing concrete surface in color. It has been in use for centuries with lime mortar as its medium. As applied today, there are two general ways of proceeding. The colored mortars may be applied to the whole surface, one coat over another, and the various parts of the design etched or carved to the layer of the desired color. A similar effect is obtained by the use of stencils cut from oilcloth.

The decorative treatment of minor structural forms such as brackets, medallions and ornament in high relief has, from the beginning of the use of concrete, been cast in "plaster waste molds." The technique of the waste mold is old to the sculptor, since for ages it has been the means of preserving his first clay sketches in a more durable material. Perhaps the method is too old and fixed to permit of its serving an entirely new material.

When either technique or decoration claim attention for themselves, it is at the expense of its service to architecture. It is at the point of its evolution where it is ready to become a separate and distinct art. This does not condemn waste mold ornament, but there is in demand a more direct and simple means for the production of relief ornament on concrete structures. In fulfillment of this demand it is believed that there is great promise in the cement gun.

When first deposited, Gunite is capable of being readily carved. And if it is carved too deeply, it is easily replaced. It possesses an advantage over clay in its ability to stand without supporting armatures. It is more readily applied in large areas or masses than is clay which must be consolidated a handful at a time. It is more quickly and easily carved than clay because loosened parts fall without troublesome tenacity. Gunite is, therefore, a medium that invites the greatest of freedom in the block-in of relief ornament.

While all of these carefully thought-out methods of handling concrete surfaces were being applied to the front elevations and interiors of the principal rooms, there was always going on a more simple and economic treatment of the rear elevations and boiler rooms of the same buildings. Rough grained, undressed lumber was being used in such locations; ledger boards were left untrimmed and here and there the accidental overlapping of ⅞-in. boards was permitted. Where such surfaces happened to come against those that had been kept smooth, there resulted a contrast of unexpected vividness and value.

In time, it was discovered that within these rough, acci-

The Ferro-Concrete Style by Dr. Francis S. Onderdonk, Courtesy Architectural Book Publishing Company

The carvings in fine aggregate concrete in St. Louis, Villemomble, made before the material had hardened sufficiently to fracture in cutting, have the character of Gunite carvings.

Paul Tournon, architect. M. Sarrebezolles, sculptor.

dental particulars of the rear elevations there was a lesson to be learned. The lesson is one of the simple, natural treatment of concrete surfaces and respect for structural forms. Designers seem to be well agreed that this is a most promising direction in which to work. Of the many relations to be studied, the one of chief importance at the present stage or loop of the evolution of architectural concrete is that existing between the structural and decorative forms.

Historic styles of architecture have until the present time dealt with but two general forms of structural elements. These have been classed as the supporting and spanning elements. The supporting elements are divided into columns and bearing walls, and the spanning elements into beams and arches. Columns and bearing walls have been considered as the carriers of direct compressive stresses due to load. The stresses carried by beams have been conventionally divided into shear and moment. Until the advent of reinforced concrete, the normal stressing of arches and vaults was a controlled or directed compression held by shape and weight to the middle third of the arch section. In all historic styles of architecture, the forms or shapes of these structural elements and the relative dimensions or proportions of them have become fairly fixed by the kind and magnitude of their stresses.

The coming of reinforced concrete has brought with it the first changes of sufficient importance to interrupt the long chain of developments that has attended architectural history. Steel construction introduced but did not develop this change. The change was not sought or even foreseen by engineers and architects, and there are now to be seen many attempts on the part of both to forestall and avoid it. The change was inherent from the first in the natural characteristics of the new material. It refused to yield its economic advantages so long as it was considered as a substitute for any jointed or articulated form of building material. The dominant character of reinforced concrete is its homogeneity, unity and rigidity, and these dominant qualities of the material must be recognized in every design that is to be successfully executed in the material.

As a result of the dominant characteristic of reinforced concrete, the time honored classification of structural elements is no longer applicable. No logical distinction, on the basis of appropriate stress, can now be made. Columns, beams, arches and vaults blend one into the other because no structural member is to be found that does not at once carry a combination of both direct and flexural stresses. What once existed as law in the "orders of architecture," the "proportions of intercolumnation," the "relations of solids and voids" and the laws of "structural ornament" now become mere rules applicable only to particulars.

Much of the bunk and flimflam that once prohibited the investigation of the stresses in unusual forms of continuous structures have now been, fortunately, swept aside. Now the architect can afford to investigate a whole new category of basic structural forms. Many of these forms seem to be peculiarly fitted to the characteristic qualities of reinforced concrete as a building material.

If we may designate a structural element by the same name as that of its most closely related mathematical surface, some most promising new elements emerge. These elements fall into two classes; first, those that are capable of being hooped—such as the hemisphere and its segments; the various intersections of the ellipsoid, paraboloid and toris, and the various intersections of pseudospheres. Those of the second class are incapable of being hooped—the cylindrical surfaces generated by straight lines in contact with the plane curves corresponding in name to those above.

As in Gothic vaulting, there is an almost infinite number of combinations of these new surfaces that are capable of being built and adapted to plan requirements. By this list, we are reminded that the arts of man are never at a loss in producing variety—there is always plenty from which to select. It is to be noted that none of these forms is of either the beam or column type. Each of the surfaces mentioned is by its own weight subjected to the action of combined stresses. Each, under certain conditions, is capable of serving to replace beams or columns; and when finally developed, the future architecture will display little distinction between these two types of structural elements.

The new structural forms are not mere dreams of an inventive mind. Biologists point out that species in an incipient form have always existed. The mammal is represented in the reptile and the reptile in the amphibian. The same principle of evolution is evident in the arts of man. A close student of patent reports asserts that no man has ever invented anything. And so it is with the new architectural forms. Paraboloidal towers and domes antedate the historic architecture of India. A similar form carries the dome of the baptistry of Florence. A more perfectly formed type of the same, cut by four inclined planes, supports the dome of the Pantheon in Paris. These are masonry; but on the outskirts of Vienna the same forms are adapted to modern plan-requirements and built of concrete. In France, a new cathedral has been built recently in which columns and beams are omitted and the new structural forms started from the foundations.

Architecture is an example of evolutionary growth, and architectural concrete its most promising present variation. Whatever may be its future, it is already fixed; but the speed with which we arrive at any particular stage of its development depends upon our understanding of the natural principles of design.

A. W. STEPHENS, consulting engineer, New York City, was special consultant on structural design of the new S. H. Kress Company building in that city, to be built soon by Barr, Irons and Lane, Inc., contractors. Seven stories and basement, the building was designed for store and executive offices by E. F. Sibbert, architect for the Kress Company. Construction will consist of one and two-way reinforced concrete floors and roofs.

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Painting is nearly completed on the $375,000 monolithic concrete Atlanta Police Station and Jail, which has been occupied since late in November. Burge and Stevens, architects; Robert G. Lose, structural engineer; Pittman Construction Company, builders—all of Atlanta.

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Rapid progress is being made by John Griffith and Sons, contractors, Chicago, in concrete work on the huge lock at Alton, Ill., largest structure in the Upper Mississippi River development. Since first concrete was deposited August 20, more than 40,000 cu. yd. have been placed. Best run was 1,900 cu. yd. between 6 A.M., November 5 and 8 A.M., November 6.

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It is reported that the Struck Construction Company, Louisville, Ky., was low bidder on the monolithic concrete Georgia State Prison at Reidsville, designed by Tucker and Howell, Atlanta architects. Bid was $1,083,000. Robert S. Fiske, structural engineer.

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An autumn issue of L'Artisan Liturgique, French religious and architectural magazine, devoted prominent space to a profusely illustrated article on the monolithic concrete St. Joseph's Church, Seattle. Architect for this beautiful edifice was A. H. Albertson with Joseph W. Wilson and Paul Richardson, associates, all of Seattle. A. D. Belanger and Company, also of Seattle, were contractors.

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Arthur A. Johnson, Long Island City, has been awarded contract for construction of concrete core wall of the Quabbin Reservoir at Enfield and Ware, Mass., at $1,446,775. The engineer in charge for the Metropolitan District Water Supply Commission is Frank E. Winson of Boston.

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The U. S. Treasury Department has awarded James Stewart and Company, New York City, a contract for erection of nine story and basement Federal Office Building on Vesey Street. The bid was $5,597,000. Plans prepared by Cross and Cross, New York architects, call for reinforced concrete floors and roof.

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Simpson Brothers Corp., Boston, has submitted low bid of $57,847 for construction of first rigid frame reinforced concrete bridge in New England designed to carry railroad loading. The bridge will carry two main tracks of Midland division of New York, New Haven and Hartford Railroad over an extension of Nahatan Street in Norwood, Mass. Clear span of 68 ft. and roadway width of 50 ft.; plans were prepared by G. E. Harkness, bridge engineer of Massachusetts Department of Public Works.

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The Pennsylvania State Highway Department recently awarded contract to R. D. Thomas & Company, Pittsburgh, for the construction of a five-span, open spandrel type reinforced concrete arch bridge to be constructed on the Lincoln Highway near Bedford. This bridge will be 588 ft. in length, with a 20-ft. roadway. Contract price is $264,321, including 1,984 ft. of concrete pavement.

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JOHNSON, DRAKE & PIPER, general contractors, Minneapolis, report that construction of the monolithic concrete Administration Building at Ft. Peck Dam, N. D., is practically completed. Plans and specifications were prepared in the U. S. Engineer's office at Kansas City.

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George F. Driscoll Co., Brooklyn, N. Y., was recently awarded contract for construction of concrete Piers 90 and 92 at 50th and 52nd streets and North River, New York City. Pier structures are one and two stories high, 1100 ft. by 125 ft. in plan. Contract price for Pier 90 was $546,334; for Pier 92, $556,834.

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J. P. Heffernan, Boston architect, has received bids for the construction of a three-story Vocational School for the City of Somerville, Mass. The building will have reinforced concrete frame, floors and roof; cast stone exterior trim and cinder concrete masonry partitions.

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CORRECTION

Fritz Kubitz (not Kublitz) of Pittsburgh was structural engineer on the New Gulf Refining Company Buildings, at Harmarville, Pa., as reported in the preceding issue.

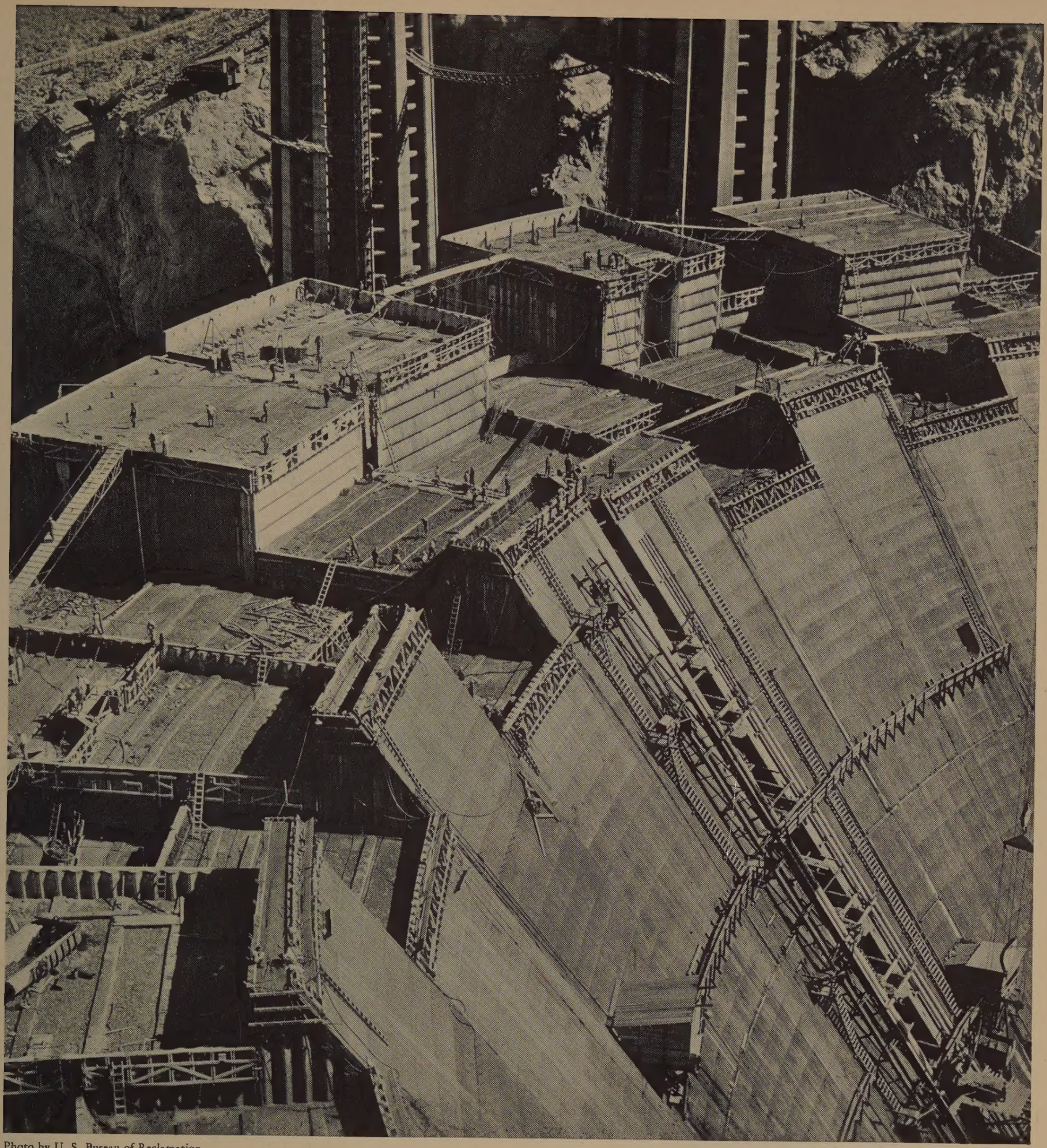
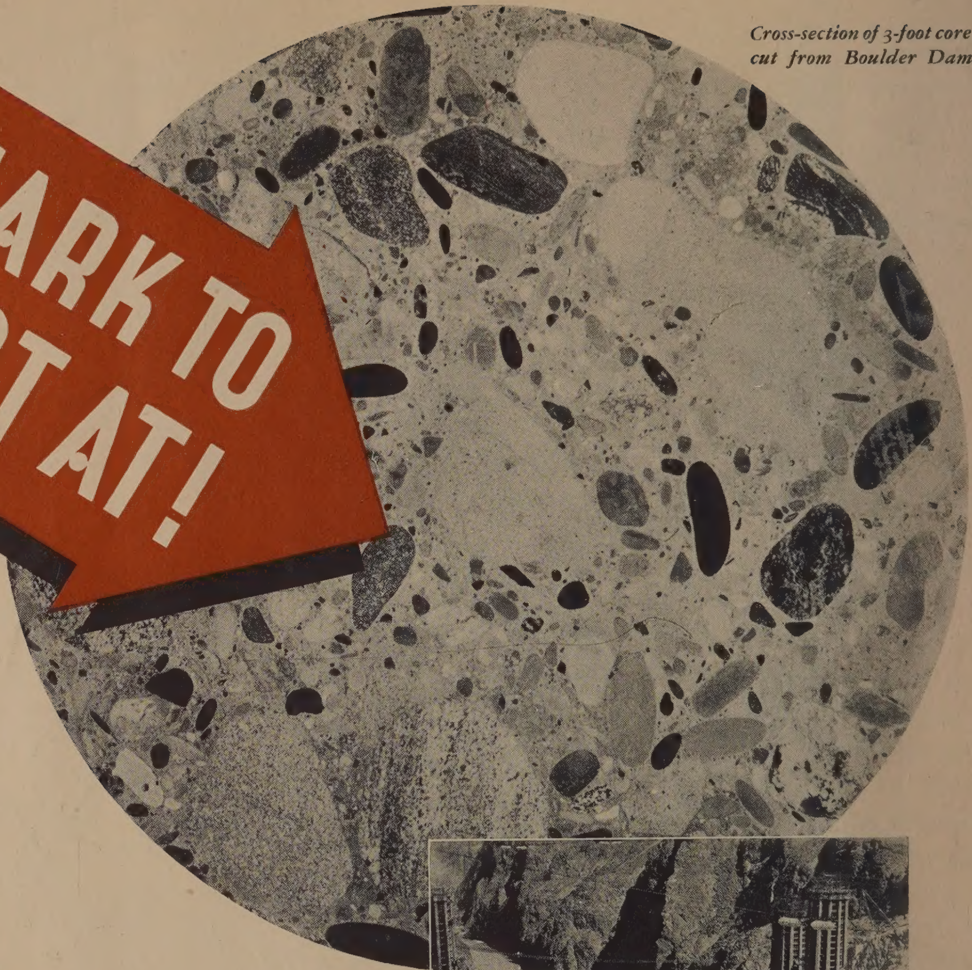


Photo by U. S. Bureau of Reclamation

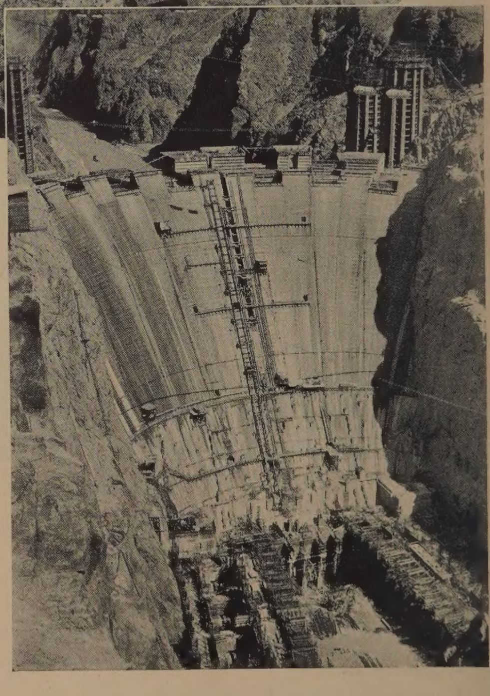
Looking Down on
BOULDER DAM
Bureau of Reclamation Project
Six Companies, Contractors

Architectural Concrete? Why not! It has form and line; in its own way—grace, beauty and majesty. It is a daily changing detail of giant proportions. It is a dream of men created by craftsmanship and toil.

A MARK TO SHOOT AT!



Cross-section of 3-foot core cut from Boulder Dam



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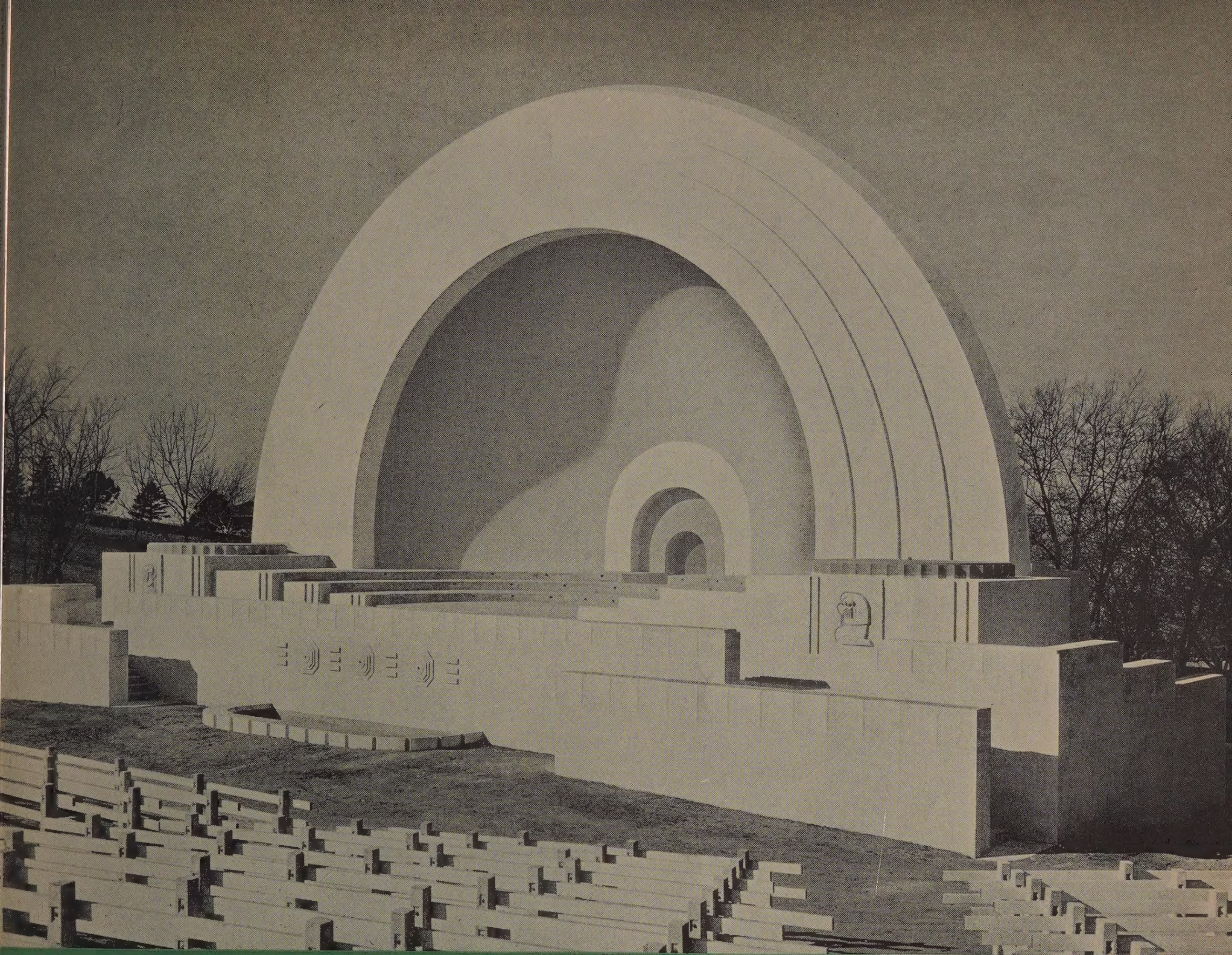

ARCHITECTURAL CONCRETE

VOLUME ONE NUMBER THREE

MUSIC PAVILION

Sioux City, Iowa

Henry L. Kamphoefner, Architect

Paul Cook and Bruce Packard, Engineers

C. I. Small, Commissioner of Public Works

Without concealing the purpose of his structure "behind false forms," Mr. Kamphoefner has produced a beautiful and appropriate setting for orchestra and theater—a stage whose lines and proportions suggest music. The simple treatment of all elevations—see cover—is consistent with the architect's intention to subordinate detail to mass.